

NON-PUBLIC?: N
ACCESSION #: 8802020148
LICENSEE EVENT REPORT (LER)

FACILITY NAME: St. Lucie, Unit 2 PAGE: 1 of 4

DOCKET NUMBER: 05000389

TITLE: Reactor Trip On Loss Of Load Caused By Main Generator Exciter Bearing
Failure Due To Personnel Error
EVENT DATE: 11/25/87 LER #: 87-007-01 REPORT DATE: 01/29/88

OPERATING MODE: 1 POWER LEVEL: 050

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: A. B. Johnson, Shift Tech. Advisor TELEPHONE #: 305-465-3550

COMPONENT FAILURE DESCRIPTION:
CAUSE: A SYSTEM: TB COMPONENT: EXC MANUFACTURER: W120
REPORTABLE TO NPRDS: N

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: On 25 November 1987, St. Lucie Unit Two was operating at 50 percent power steady state in Mode 1. At 2331 hours, the reactor tripped on loss of load due to a turbine trip. The turbine tripped on a main generator lockout. The failure of the main generator exciter bearing caused the armature of the Permanent Magnet Generator (PMG) to grind into its stator. When this occurred, the PMG discontinued supplying voltage to the exciter of the main generator. This trip was uncomplicated and the unit was quickly stabilized in Mode 3, Hot Standby.

The root cause of the event was a personnel error during the performance of the weekly generator exciter ground check on which a prolonged ground resulted in the failure of the generator exciter bearing.

The following corrective actions have been implemented: replaced the PMG and the exciter bearing, removed the exciter bearing thermocouple to prevent future grounding occurrence of this type, procedures have been revised to ensure any future grounds are recognized, and training was given to all Electrical Maintenance personnel for better understanding of the exciter ground check.

(End of Abstract)

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DESCRIPTION OF EVENT:

On 25 November, 1987, St. Lucie Unit Two was operating at 50 percent power steady state in Mode 1. The unit was returned to service on 23 November following a refueling outage and was holding at 50 percent power while repairs were in progress on the 2A Steam Generator Feed Pump (SGFP) (EIIS:SJ) due to a small water leak that developed on the vent line at the pump casing. The reactor was being maintained in a steady state condition with all automatic controllers placed in automatic with the exception of the Control Rod Drive System (EIIS:JD) which was in OFF.

At 2331 hours, the Reactor Protective System (EIIS:JC) initiated a reactor trip on loss of load due to a turbine trip. The turbine tripped on a main generator (EIIS:TB) lockout. The control room was alerted with information that smoke was seen coming out of the Main Generator Exciter (EIIS:TL). The Assistant Nuclear Plant Supervisor (ANPS) instructed the Turbine Operator (TO) to check for rubs on the rotating components of the turbine-generator. The TO reported evidence of turbine-generator rubs to the control room and the ANPS instructed the Reactor Control Room Operators (RCOs) to open the vacuum breakers on the main condenser (EIIS:SG) to aid in slowing down the turbine. A fire team was assembled and stationed with fire fighting equipment at the vicinity of the main generator exciter. There were no reports of an actual fire.

The trip was an uncomplicated trip and all systems functioned normally. The System Bypass Control System (SBCS) (EIIS:JI) operated to reduce primary average temperature (T-avg) to the zero percent power setpoint of 532 degrees F. Auxiliary feedwater (EIIS:BA) was initiated manually to control the steam generator (S/G) level for Reactor Coolant System (RCS) (EIIS:AB) heat removal. The standard post trip actions were completed and the unit was immediately stabilized in Hot Standby, Mode 3.

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CAUSE OF THE EVENT:

The immediate cause of the main generator lockout was loss of the generator field. The loss of field was caused by destruction of the exciter Permanent Magnet Generator (PMG) that occurred when the exciter bearing failed allowing the PMG armature to rub on the PMG stator.

Further investigation into the failure of the exciter bearing indicated that a ground was caused by a completed electrical circuit between the exciter bearing and the exciter base. This completed electrical circuit bypassed the insulation between the bearing pedestal and the exciter base. The ground was caused by an improper installation of an instrument cable (EIIS:IT). The instrument cable provides the terminal connection from the thermocouple of the #9 exciter bearing housing to its terminal box, which provides remote temperature indication in the control room. The as-found condition of the instrument cable indicated that the braided wire cable shield was not properly positioned in the clamp; therefore, a ground developed at the exciter bearing. Examination of the exciter bearing revealed pitting marks on the bearing surface, characteristic of current flowing across the bearing journal to the bearing pad, which resulted in the bearing failure.

The improper arrangement of the instrument cable cannot be conclusively identified as a wiring error during the installation of the new main generator exciter. The PMG and the instrument cable were meggered to detect for possible grounds and the results were acceptable. It has been postulated that one of two circumstances may have occurred: 1) the instrument cable was installed correctly with the braided wire shield in the clamp when it was meggered; then at some later date, the instrument cable was accidentally stepped on causing the cable shield to become separated from the clamp; or 2) the instrument cable, being clamped incorrectly to the pedestal, had not yet been connected to the terminal box when the megger test was performed.

After placing the main generator back in service, the ground should have been detected during the performance of the weekly generator exciter ground check. The preventative maintenance Plant Work Order (PWO) requires voltages to be read across the #9 bearing shaft to ground and across the #9 bearing pedestal to ground. The data is to be evaluated to ensure no grounds have developed in the main generator exciter. Early recognition of the ground would have prompted immediate action to remove the main generator from service for the necessary repairs.

The root cause of the event was a cognitive personnel error by a utility maintenance supervisor in misinterpretation of the main generator exciter ground voltage readings. The appropriate procedure was properly followed. However, lack of understanding of the significance of the generator exciter ground check and inadequate acceptance criteria in the PWO were contributing factors in the personnel error. There were no unusual characteristics of the work location that directly contributed to the personnel error.

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ANALYSIS OF THE EVENT:

The event is reportable under 10 CFR 50.73(a)(2)(iv), "any event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature, including the Reactor Protection System."

This event was observed to be a routine reactor trip on loss of load. The resulting transient was well enveloped by the St. Lucie Unit #2 Final Updated Safety Analysis Report section 15.2.1.2 "Limiting Reactor Coolant System Pressure Event-Isolation of Turbine (100% power)." All Plant Safety Functions were met and there were no additional complications. Consequently, the health and safety of the public were not affected by this event.

CORRECTIVE ACTIONS:

1. The Permanent Magnet Generator was replaced.
2. The Exciter Bearing was replaced.
3. An evaluation was made and the Exciter Bearing thermocouple was determined to be unnecessary and it was removed to prevent future incidents of this type.
4. The preventative maintenance plant work order was revised to adequately define the acceptance criteria and the proper actions when the acceptance criteria are not met.
5. Training was given to all Electrical Maintenance personnel to elaborate on the importance of properly evaluating the data during performance of the weekly generator exciter ground check.
6. The plant training group will evaluate this item to determine appropriate training requirements and methods.

ADDITIONAL INFORMATION:

FAILED COMPONENT INFORMATION:
Westinghouse Exciter Bearing (#9 bearing)
Part #613F432 G01

PREVIOUS SIMILAR EVENTS:

See LER #389-84-011 for a previous reactor trip due to exciter bearing failure.

ATTACHMENT # 1 TO ANO # 8802020148 PAGE: 1 of 1

P. O. BOX 14000, JUNO BEACH, FL 33408-0420

FPL

JANUARY 29 1988

L-88-41
10 CFR 50.73

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Re: St. Lucie Unit 2
Docket No. 50-389
Reportable Event: 87-07 Revision 1
Date of Event: November 25, 1987
Reactor Trip on Loss of Load Caused by Main Generator
Exciter Bearing Failure Due to Personnel Error

The attached Licensee Event Report (LER) is being submitted pursuant to the requirements of 10 CFR 50.73 to provide an update on the subject event.

Very truly yours,

/s/ C. O. Woody
C. O. Woody
Executive Vice President

COW/GRM/gp

Attachment

cc: Dr. J. Nelson Grace, Regional Administrator,
Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant

GRM/022.LER

*** END OF DOCUMENT ***
